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Reference Materials for Water and Wastewater Analyses in USEPA (U.S. Environmental Protection Agency)

(U.S.) Environmental Monitoring and Support Lab.
Cincinnati, OH

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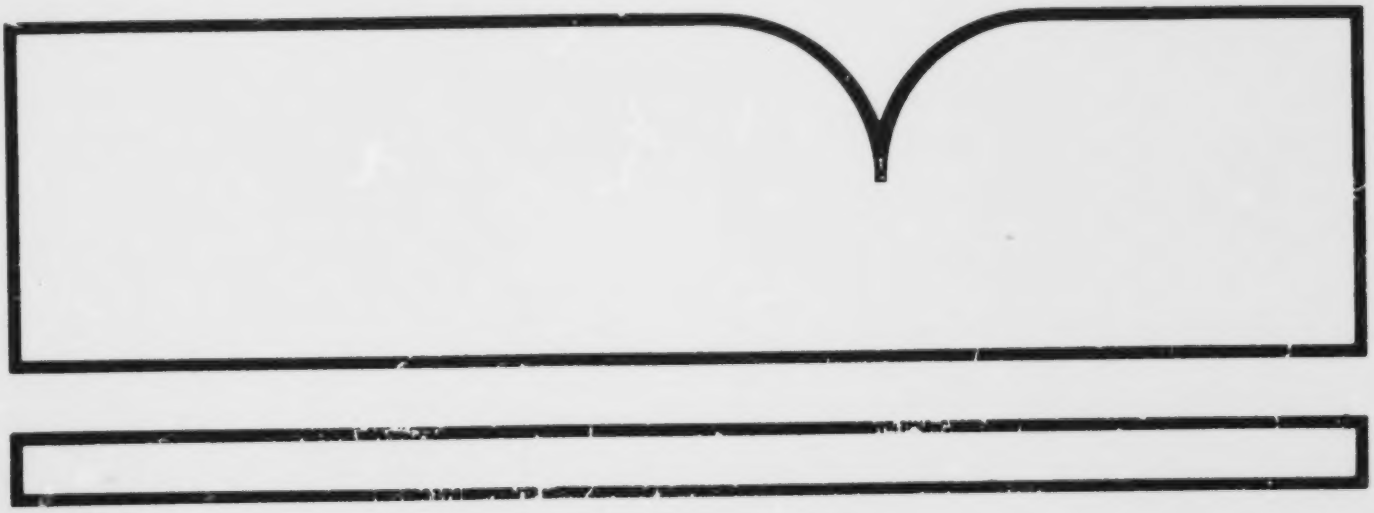

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Reference Materials for Water and Wastewater Analyses in USEPA

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ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
OFFICE OF RESEARCH AND DEVELOPMENT
U.S. ENVIRONMENTAL PROTECTION AGENCY
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16. ABSTRACT

The Environmental Monitoring and Support Laboratory at Cincinnati provides quality assurance support for EPA's water-related programs in response to the Clean Water Act, the Safe Drinking Water Act, the Marine Protection, Research and Sanctuaries Act, the Resources Conservation and Recovery Act, the Comprehensive Environmental Response Compensation and Liability Act, and the Toxic Substances Control Act.

Two important segments of this support are: 1) the Quality Control (QC) Sample Program which provides samples of known concentrations for use as independent Hazardous Materials which provides calibration standards for trace organic analyses of interest to the Agency.

The samples and standards are prepared as stable concentrated solutions in all-glass ampuls. Each series contains one or more related analytes, each with a true or reference value. These are provided for dilution to volume and analyses as needed by EPA, EPA contractor/grantees, and other federal, state and local agencies.

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NOTICE

This document has been reviewed in accordance with U.S. Environmental Protection Agency policy and approved for publication. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

ABSTRACT: The Environmental Monitoring and Support Laboratory at Cincinnati provides quality assurance (QA) support for EPA's water-related programs in response to the Clean Water Act (P.L. 92-500), the Safe Drinking Water Act (P.L. 93-523), the Marine Protection, Research and Sanctuaries Act (P.L. 92-532), the Resources Conservation and Recovery Act (P.L. 94-580), the Comprehensive Environmental Response Compensation and Liability Act (P.L. 96-510), and the Toxic Substances Control Act (P.L. 94-469).

Two important segments of this support are: 1) the Quality Control (QC) Sample Program which provides samples of known concentrations for use as independent checks on intra laboratory QA activities, and 2) the USEPA's Repository for Toxic and Hazardous Materials which provides calibration standards and spiking solutions for trace organic analyses of interest to the Agency. Each series contains one or more analytes, with true or reference values. The samples and standards are prepared as stable concentrated solutions in all-glass ampuls for dilution to volume, and analyses by USEPA, its contractors and grantees, and other federal, state and local agencies.

KEY WORDS: Reference materials, calibration standards, quality control samples, quality assurance, water/wastewater analyses, interlaboratory quality control

Background

The US Environmental Protection Agency (EPA) was formed in 1970 as a new era in pollution control began in the United States. With the passage of the Federal

Water Pollution Control Act Amendments of 1972 (P.L. 92-500), the Marine Protection, Research, and Sanctuaries Act of 1973 (P.L. 92-532), and the Safe Drinking Water Act of 1974 (P.L. 93-523), the Congress had passed laws with the means to regulate effluent discharges, ocean dumping of wastes, and contaminants in drinking water. These laws were followed with hazardous waste legislation governing the manufacture, use, and disposal of organic and inorganic chemicals in the U.S.: the Federal Insecticide, Fungicide, Rodenticide Act Amendments of 1972 (P.L. 92-583); the Toxic Substances Control Act of 1976 (TSCA), P.L. 94-469; the Resource Conservation and Recovery Act of 1976 (RCRA), P.L. 94-580 (Solid/Hazardous Wastes); and, the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA), P.L. 96-510, (Superfund).

Concurrently, with the 1972 Clean Water Act Amendments, EPA realized that the generation of legally-defensible data under these laws required assurance of data quality, so it established a formal quality assurance program.

Then in 1979, the EPA Adminstrator, Douglas M. Costle established the EPA Policy on mandatory Quality Assurance with his memorandum statement of May 30. "... I am making participation in the QA effort mandatory for all EPA supported or required monitoring activities...Monitoring is defined as all environmentally related measurements which are funded by the EPA or which generate data mandated by EPA." Consequently, quality control practices including use of reference materials have become requirements for all EPA's environmental measurements. Because many

chemical products and wastes are disposed directly to water or indirectly to water via run-off or leaching from land disposal sites, EPA's quality assurance (QA) program for water was expanded beyond the water laws to these hazardous waste regulations.

As the laboratory responsible for water and wastewater QA, EMSL-Cincinnati performs six QA functions in support of the Mandatory Quality Assurance Program:

Develops/Selects Sampling, Sample Preservation, and Analytical Methodology

Conducts Interlaboratory Method Validation Studies

Conducts Interlaboratory Performance Evaluation Studies

Establishes QC Guidelines

Maintains a QC Sample Program

Maintains the EPA Repository for Toxic and Hazardous Materials.

Development of a Reference Material Programs

Reference materials for quality assurance must meet the needs of EPA's operating programs in Industrial Wastewater, Ambient Water Quality, Drinking Water, Solid Wastes, Superfund, and Chemical Testing and Assessment. Reference materials

are developed for these programs as pure standard materials for calibration, surrogate compounds for monitoring recovery, interference check samples, and quality control samples. Sample design is tailored for pre-treatment or clean-up requirements, analytes, range of concentrations, and acceptance limits specified in a particular regulation. Ideally, reference materials, should meet the prime needs of one program while being general enough to be useful to other programs.

One of the first steps in establishing a reference materials program was to develop a sample which could be prepared and distributed economically to a large number of EPA, state and local laboratories. The objectives of the design were to have: 1) exact known concentrations of the test parameters; 2) multiple parameters/sample; 3) homogeneous replicate sample series; 4) stability for at least 1 year; 5) control of evaporation and leakage; 6) use in a variety of waters; 7) applicability to EPA methodology; 8) efficient and economical preparation, storage and shipment; and 9) separate measure of bias and interference. These objectives were judged most achievable with the preparation of solutions of synthetic sample concentrates from pure chemicals, which were then sealed in all-glass ampuls. All-glass ampuls of 5-20 mL volume became the basic sample units for the QC Sample Program.

The concentrates are prepared in natural groupings of analytes such as trace metals, minerals, and nutrients. True values are established for all synthetic samples. The true value is defined as amount of chemical calculated, weighed, added, and verified by repeated analyses over time by independent laboratories. Establishment of true values permits the analyst to measure accuracy, a critical measure of analytical performance.

The production operations of ampul cleaning, drying, filling, sealing and labelling are accomplished efficiently on small scale production equipment designed for the pharmaceutical industry. Each batch of 1000 - 5000 ampuls of a sample type is prepared in one working day without interruptions. This continuous operation is a critical quality control factor in maintaining sample series homogeneity.

Stability and Storage

If ampuls are sealed properly, the contents will not leak, evaporate, or become contaminated from caps, or cap liners. Samples in ampuls are easily stored in a minimal amount of space. Further, the costs of handling and shipment are very low compared to full-volume samples. For example there is a space savings factor of 16X and a weight savings factor of 32X for 20 mL ampuls as compared to full volume liter samples. Samples in all-glass sealed ampuls are stabilized for most inorganics and some organics by steam sterilization, for trace metals by acidification, and for most organics by concentrating the analyte and by use of a specific solvent. The preparation of samples as concentrates also permits the preparation of analytes at concentrations several magnitudes higher than dilute samples, i.e., at mg/liter not µg/liter levels. Concentrations in the mg/liter level tend to be more stable than lower levels. Acceptable stability (results within 95% C.L.) is required for one year; however, most series are stable beyond the year.

Verification of Sample Values

After preparation of a sample series, ampuls are selected from throughout the production run to verify the true value and homogeneity of the series. Analyses are then repeated at 30, 60 and 90 days to establish stability. Concurrently, samples are sent as unknowns to two or more referee laboratories for confirmation of values. Results must be within 95% confidence limits. If data do not agree among the laboratories, or analyzed values are outside of the acceptable range, the situation is reviewed, and samples reanalyzed. If the analytical differences are determined to be real and caused by sample variability or inaccuracy, the sample series is discarded and a new series begun. True values are not adjusted to meet analyzed values. Once a series is approved, check analyses are performed at six-month and yearly intervals until the supply is exhausted.

Use of Quality Control Samples

Quality control samples are provided with instructions for sample preparation and analyses, a statement of true values and 95% confidence limits, as a gauge of acceptability of individual analyst performance. Samples are provided at two levels; one somewhat above the detection level, at a level selected for discharge permits, or at maximum contaminant levels (MCL's). A second level is set at some point higher on the calibration curve so that the range of concentrations simulates real world samples. By adding an aliquot to a volume of reagent water, the analyst can measure the inherent precision and accuracy of the method. By adding an

aliquot to a volume of tap, ambient or wastewater and calculating a by-difference recovery, the analyst can compare reagent water and natural water recoveries and detect matrix interferences. As a prime support in within-laboratory QC programs, the QC samples are used as an independent check on calibration, standards, analytical techniques, instruments, or analysts. They are not intended as a substitute for standards, spiked samples or replicates which should be run as a normal part of the within-laboratory QC program.

Tables 1A-1D, list the present series of QC samples which are available. Table 1A, Drinking Water (WS) Series covers all MCL parameters in paired samples, with the lower value somewhat above the MCL, plus residual chlorine, sodium, and corrosivity.

Table 1B contains the 22 QC sample series for general water pollution parameters. The Table also contains linear alkylate sulfonate (LAS), the official anionic surfactant standard needed for the surfactant test, and five natural matrix samples. The special matrix samples--pesticides in fish, PCB's in fish, PCB's in sediment, trace metals in fish, and municipal digested sludge--were obtained from collection of large amounts of environmentally-contaminated materials. The collected materials were screened, ground, freeze-dried and blended. Reference values are provided based on repeated analyses by the developer and three or more referee laboratories. As expected, data on such samples exhibit a wider range of variability than data from synthetic water samples.

Limited types of biological QC sample materials are available (chlorophyll, phytoplankton and simulated plankton), as shown in Table 1C. Although chlorophylls are considered unstable, protection from light and storage at freezer temperatures permit the maintenance of chlorophylls with firm reference values based on a very slow predictable rate of change. Careful monitoring permits periodic adjustment of these values.

Table 1D contains a detailed listing of QC samples for priority pollutants and hazardous compounds identified in RCRA, CERCLA, and TSCA. These sample concentrates are prepared in water-miscible organic solvents for spiking into water samples, extraction, and analyses. The priority pollutant sample series are broken into the categories for gas chromatography (GC), high performance liquid chromatography (HPLC), and gas chromotography/mass spectrometry (GC/MS) analyses based on EPA's "600 series methods"[(1)]. Where large numbers of compounds are contained in a category such as polynuclear aromatic hydrocarbons, the category is broken into two or more series.

Because the trace organic series for RCRA, CERCLA, and TSCA are based on anticipated presence or discovery in wastes or dump sites, the list of chemicals continues to grow and change as further field monitoring identifies new potential hazards.

The EPA Repository for Toxic and Hazardous Materials

Frequently, analytical results from two or more laboratories do not agree, and an investigation is conducted to identify causes. Often the problem is caused by the use of calibration standards of variable purity or the variable presence of contaminant compounds. Further, as toxic compounds are identified and their uses restricted or prohibited, compounds are no longer available from supply houses. With sales uncertain, many compounds may not be available in the future.

With the uncertain availability and variable quality of organic standards, and the extremely high costs of special syntheses, EMSL-Cincinnati established the EPA Repository for Toxic and Hazardous Materials as the permanent source of high purity chemicals for use as calibration standards, spiking solutions, surrogates, and internal standards. Three grades of standards are prepared: Quality Assurance Standards (QAS) with purity $\geq$ 99 percent, Quality Assurance Reagents (QAR) with purity $\geq$ 95-98 percent, and Quality Assurance Technical Grade (QAT) with purity < 95 percent.

The Repository Functions are:

1. Procurement chemical compound of highest available purity.

2. Synthesis of a compound if not available or if purchase cost exceeds cost of synthesis. The neat compound is verified for percent purity by use of referee laboratories.

3. Purification, if compound is less than 99 percent pure. Exceptions are the mixtures which are accepted as is; examples are the PCB's and toxaphene.

4. If purity is satisfactory, preparation of a solution in organic solvent and sealed in glass ampuls. The concentration is verified through use of referee laboratories..

5. Distribution of sealed ampuls on request, with a specification sheet providing background information on compound identification, source, synonyms, CAS number, EPA number, details on solution preparation, storage, hazards, and a reference chromatogram by GC or GC/MS. The compounds are usually prepared in acetone or methanol for use as water sample spikes or as calibration standards. Table 2A lists the currently available chemicals.

The Future of EPA's Reference Materials Program

The QC Sample Program and the EPA Repository Reference Materials are intended to cover all trace organics identified in solid/hazardous wastes, superfund, and toxic substances control, and drinking water programs. The present Repository of approximately 150 compounds will probably exceed 1000 compounds in the future.

New QC samples are being tailored in concentrations and complexity for specific instruments such as GC, and GC/MS, Atomic Absorption Spectrometry (AA), and Inductivity-Coupled Plasma (ICP). Additional biological QC samples and calibration materials are being considered, as bioassays and toxicity tests are proposed as less expensive alternatives to testing for specific chemicals in effluents. The biological samples include standard toxicants and biological test cultures. Quality Control is being incorporated into methodology. As requirements for use of

surrogates, internal standards, calibration materials, QC samples and interference check samples are incorporated into all new analytical methods, new QC samples are required.

Finally, the need to perform a full range of organic and inorganic analyses on wastes, sludges, and sediments necessitates the expansion of the QC sample series to natural matrix samples to fully challenge the analytical methods, instruments and analysts. However, such samples are extremely expensive to develop and analytical costs are increased greatly by the need for extensive and repeated analyses to establish reference values.

The potential for expansion of the QC Sample Program and The Repository for Toxic and Hazardous Materials is great; the rate of expansion will be controlled largely by the level of support available. It is hoped that a steady rate of growth in reference materials can be maintained to meet the Agency's major program QA needs for reference materials.

As the QC sample series and the repository standard list expand, the Quality Assurance Branch of EMSL-Cincinnati communicates update information in the Quality Assurance Newsletter, distributed quarterly to interested parties. A laboratory may be placed on the distribution list by contacting the Editor, QA Newsletter, US EPA, EMSL-Cincinnati, Cincinnati, Ohio 45268.

REFERENCE

1. 40 CFR, Part 136. Guidelines Establishing Test Procedures for the Analysis Pollutants; Proposed Regulations, pp. 69464-69575, December 3, 1979.

TABLE 1A

QUALITY CONTROL SAMPLES FOR DRINKING WATER ANALYSES

CORROSIVITY/SODIUM	Langlier's Index Value and Sodium in water, one level
HERBICIDES	2,4-D, 2,4,5-TP (Silvex), two levels, in methanol
NITRATE/FLUORIDE	nitrate-N and fluoride, two levels
CHLORINATED HYDROCARBON PESTICIDES - WS I	endrin, lindane, and methoxychlor, two levels, in acetone
CHLORINATED HYDROCARBON PESTICIDES - WS II	toxaphene, two levels, in acetone
RESIDUAL FREE CHLORINE	two levels
TRACE METALS - WS	arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver, two levels
TRIHALOMETHANES	chloroform, bromoform, dichlorobromomethane, and chlorodibromomethane, two levels, in methanol
TURBIDITY	two levels

TABLE 1B

Quality Control Samples for Water Quality Analyses

DEMAND ANALYSES	BOD, COD, TOC, two levels
ICAP - I	Al, As, Ba, Be, Ca, Cd, Cr, Cu, Co, Fe, K, Mg, Mn, Mo, Na, Ni, Pb, Sb, Se, Ti, Tl, V, and Zn
ICAP - II	Ag, B, and SiO_2
ICAP INTERFERENCE - I	As, Ba, Be, Cd, Co, Cr, Cu, K, Mn, Mo, Ni, Pb, Sb, Se, Ti, Tl, V, and Zn
ICAP INTERFERENCE - II	Al, Ca, Fe, Na, and Mg
ICAP INTERFERENCE - III	Ag, B, and SiO_2
LINEAR ALKYLATE SULFONATE	LAS, the anionic surfactant standard for the MBAS Test
MINERAL/PHYSICAL ANALYSES	sodium, potassium, calcium, magnesium, pH, sulfate, chloride, fluoride, alkalinity/acidity, total hardness, total dissolved solids, and specific conductance, two levels
MUNICIPAL DIGESTED SLUDGE	26 parameters (metals, nutrients, demands, residues, and phenols)
NON-FILTERABLE, VOLATILE AND TOTAL FILTERABLE RESIDUE	two, three levels
NUTRIENTS	nitrate-N, ammonia-N, Kjeldahl-N, orthophosphate, and total P, two levels
OIL AND GREASE	three levels, 2 analyzable by IR and 3 analyzable gravimetrically
PESTICIDES IN FISH	toxaphene, DDD, DDE, DDT
PHENOLS (4AAP Method)	two levels

TABLE 1B (continued)

Quality Control Samples for Water Quality Analyses

POLYCHLORINATED BIPHENYLS (PCBs) IN FISH	naturally-polluted fish tissue containing Aroclors 1242, 1254 and/or 1260, two levels
POLYCHLORINATED BIPHENYLS (PCBs) IN OILS	Aroclor 1016, 1242, 1254, and 1260 in transformer, hydraulic, and capacitor oils, three levels (specify Aroclor and oil)
POLYCHLORINATED BIPHENYLS (PCBs) IN SEDIMENTS	natural sediments containing Aroclor 1242 and/or 1254, three levels
TRACE METALS - WP I	aluminum, arsenic, beryllium, cadmium, chromium, cobalt, copper, iron, lead, manganese, mercury, nickel, selenium, vanadium, and zinc, three levels
TRACE METALS - WP II	antimony, silver, and thallium, two levels
TRACE METALS - WP III	barium, calcium, potassium, sodium, magnesium, molybdenum, and titanium, two levels
TRACE METALS IN FISH	arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, and zinc, one level
VOLATILE ORGANICS	chloroform, 1,2-dichloroethane, 1,1,1-trichloroethane, 1,1,2-trichloroethylene, carbon tetrachloride, 1,1,2,2-tetrachloroethylene, bromodichloromethane, dibromochloromethane, and bromoform, two levels, in methanol

TABLE 1C

Quality Control Samples for Biology

CHLOROPHYLL	fluorometric analyses, three levels, in acetone
CHLOROPHYLL	spectrophotometric analyses, one level, in acetone
PHYTOPLANKTON	duplicate ampuls preserved, in 15 mL of water. One ampul for use in taxonomic evaluation, the other for enumeration and identification of organisms (Sedgwick-Rafter counts)
SIMULATED PLANKTON	20 mL aqueous suspension of latex spheres for particle counting, and a permanent, glass slide mount of latex spheres for particle size distribution determinations

TABLE 10

Quality Control Samples for Priority Pollutants/Hazardous Wastes/Toxic Chemicals

AROMATIC PURGEABLES	benzene, toluene, ethylbenzene, p-xylene, o-xylene, and m-xylene, two levels, in methanol
BENZIDINES	benzidines and 3,3'dichlorobenzidine, two levels, in methanol
CHLORINATED HYDROCARBONS	hexachloroethane, hexachlorobenzene, 1,2,4-trichlorobenzene, o-dichlorobenzene, p-dichlorobenzene, m-dichlorobenzene, hexachlorobutadiene, 2-chloronaphthalene, two levels, in acetone
CHLORINATED HYDROCARBON PESTICIDES - WP I	aldrin, dieldrin, DDT, DDE, DDD, and heptachlor, two levels, in acetone
CHLORINATED HYDROCARBON PESTICIDES - WP II	chlordane, two levels, in acetone
CHLORINATED HYDROCARBON PESTICIDES - WP III	alpha-BHC, beta-BHC, heptachlor epoxide, endrin, aldehyde, and alpha and beta Endosulfan, two levels, in acetone
CYANIDE	two levels
DICHLOROBENZENES	3 Sets: meta and para isomers, meta and ortho isomers, and meta, ortho and para isomers, two levels each, in methanol
EP METALS	arsenic, barium, cadmium, chromium, lead, mercury, selenium, silver, two levels each, in acetic acid
GC/MS ACIDS	2-chlorophenol, 2-nitrophenol, phenol, 2,4-dimethylphenol, 2,4-dichlorophenol, 2,4,6-trichlorophenol, 4-chloro-3-methylphenol, pentachlorophenol, and 4-nitrophenol, two levels, in methanol
GC/MS BASE NEUTRALS - I	bis-2-chloroethyl ether, 1,3-dichlorobenzene, 1,2-dichlorobenzene, nitrosodipropylamine, isophorone, bis-2-chloroethoxy methane, 1,2,4-trichlorobenzene, hexachlorobutadiene, 2-chloronaphthalene, 2,6-dinitrotoluene, 2,4-dinitrotoluene, diethyl phthalate, hexachlorobenzene, phenanthrene, dibutyl phthalate, pyrene, benzo(a)anthracene, dioctyl phthalate, benzo(k)fluoranthene, two levels, in methanol

TABLE 1D (continued)

Quality Control Samples for Priority Pollutants/Hazardous Wastes/Toxic Chemicals

GC/MS BASE NEUTRALS - II	1,4-dichlorobenzene, bis-2-chloroisopropyl ether, hexachloroethane, nitrobenzene, naphthalene, dimethyl phthalate, acenaphthene, fluorene, 4-chlorophenyl phenyl ether, 4-bromophenyl phenyl ether, anthracene, fluoranthene, butyl benzyl phthalate, benzo(a)pyrene, benzo(b)fluoranthene, benzo(a,h)anthracene, benzo(g,h,i)perylene, two levels, in methanol
GC/MS BASE NEUTRALS - III	4-chlorobenzotrifluoride, m-chlorotoluene, 2,4-dichlorotoluene, 1,3,5-trichlorobenzene, 1,2,4,5-tetra- chlorobenzene, 1,2,3,4-tetrachlorobenzene, 2,4,6-trichloroaniline and pentachlorobenzene, two levels in acetone
GC/MS PESTICIDES - I	alpha-BHC, gamma-BHC, heptachlor, heptachlor expoxide, dieldrin, endrin, and 4,4'-DDD, two levels
GC/MS PESTICIDES - II	beta-BHC, delta-BHC, aldrin, alpha and beta Endosulfan, 4,4'-DDE, and 4,4'-DDT, two levels
GC/MS PURGEABLES - I	1,1-dichloroethane, chloroform, 1,1,1,trichloroethane, bromodichloromethane, bromoform, cis and trans 1,3-dichloropropane, and tetrachloroethene, two levels, in methanol
GC/MS PURGEABLES - II	methylene chloride, 1,1-dichloroethene, trans 1,2-dichloroethene, 1,2-dichloroethane, carbon tetrachloride, 1,2-dichloropropane, trichloroethene, dibromochloromethane, 1,1,2,2-tetrachloroethane, and chlorobenzene, two levels, in methanol
GC/MS PURGEABLES - III	bromochloromethane, cis 1,3-dichloroethene, 2,3-dichloro-1-propene, 1,2-dibromomethane, 1,2-dibromo-3-chloropropane and o-chlorotoluene, two levels in acetone
GC/MS PURGEABLES - IV	o-xylene, m-xylene, p-xylene and p-chlorotoluene, two levels in methanol
HALOETHERS	bis (2-chloroisopropyl ether, bis (2-chloroethoxy) methane, bis (2-chloroethyl) ether, 4-chlorophenyl phenyl ether, 4-bromophenyl phenyl ether, two levels, in acetone

TABLE 1D (continued)

Quality Control Samples for Priority Pollutants/Hazardous Wastes/Toxic Chemicals

HALOGENATED PURGEABLES - I	chloromethane, chloroethane, methylene chloride, 1,1-dichloroethylene, trans 1,2-dichloroethylene, carbon tetrachloride, bromodichloromethane, and 1,1,2-trichloroethane, two levels, in methanol
NITROAROMATICS AND ISOPHORONE	isophorone, nitrobenzene, 2,4-dinitrotoluene, and 2,6-dinitrotoluene, two levels, in acetone
NITROSAMINES	N-nitrosodimethylamine, N-nitrosodipropylamine, N-nitrosodiphenylamine, two levels, in acetone
PHENOLS (GC)	phenol, 2,4-dimethylphenol, 2-chlorophenol, 4-chloro-3-methylphenol, 2,4-dichlorophenol, 2,4,6-trichlorophenol, pentachlorophenol, 2-nitrophenol, 4-nitrophenol, and 2,4-dinitrophenol, in acetone
PHTHALATE ESTERS	dimethyl phthalate, diethyl phthalate, di-n-butyl phthalate, butyl benzl phthalate, diethyl hexyl phthalate and dioctyl phthalate, two levels, in acetone
POLYCHLORINATED BIPHENYLS	separate samples available for Aroclor 1016, 1221, 1232, 1242, 1248, 1254, 1260 and 1262 in acetone (laboratory must request specific Aroclor needed)
POLYNUCLEAR AROMATICS - I	acenaphthene, anthracene, benzo(k)fluoranthene, chrysene, naphthalene, and pyrene, two levels, in acetone
POLYNUCLEAR AROMATICS - II	acenaphythylene, 1,2-benzathracene, benzo(b)-fluoranthene, benzo(g,h,i)perylene, benzo(a)pyrene, dibenzo(a,h)anthracene, fluoranthene, and phenanthrene, two levels, in acetone
POLYNUCLEAR AROMATICS HYDROCARBONS - (PNA) SRM 1647	naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, anthracene, fluoranthene, pyrene, benzo-(a)anthracene, chrysene, benzo(k)fluoranthene, benzo-(a)pyrene, benzo(g,h,i)perylene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene, in acetonitrile, 5 ampuls/set

PLEASE NOTE: Free distribution of limited quantities of SRM 1647 is restricted to EPA laboratories, EPA contractor laboratories, and state or local government laboratories. Others may purchase SRM 1647 directly from the National Bureau of Standards, Office of Standard Reference Materials, B-311 Chemistry Building, Washington, D.C. 20234, (301) 921-2045.

TABLE 2

EPA REPOSITORY COMPOUNDS

Concentrations are 5,000 µg of QAS-pure compound per mL of methanol solvent unless otherwise noted.

Acenaphthene
Acrolein (10,000 µg/mL)**
Acrylonitrile
Benzene (10,000 µg/mL)
Benzidine
Chlorobenzene (10,000 µg/mL)
1,2,4-Trichlorobenzene
Hexachlorobenzene (1000 µg/mL)*
1,2-Dichloroethane (10,000 µg/mL)
1,1,1-Trichloroethane (10,000 µg/mL)(QAR)
Hexachloroethane
1,1,2-Trichloroethane (10,000 µg/mL)(QAR)
1,1,2,2-Tetrachloroethane (10,000 µg/mL)(QAR)
Chloroethane (10,000 µg/mL)***
bis(2-Chloroethyl) ether
2-Chloroethyl vinyl ether
2-Chloronaphthalene (10,000 µg/mL)(QAR)
2,4,6-Trichlorophenol (QAR)
Isophorone
Naphthalene
Nitrobenzene
2- itrophenol
4-Nitrophenol
2,4-Dinitrophenol (QAR)
4,6-Dinitro-o-cresol
N-Nitrosodimethylamine
N-Nitrosodiphenylamine
N-Nitrosodi-n-propylamine
Pentachlorophenol
p-Chloro-m-cresol
Chloroform (10,000 µg/mL)
2-Chlorophenol
1,2-Dichlorobenzene
1,4-Dichlorobenzene
3,3'-Dichlorobenzidine (QAR)
trans-1,2-Dichloroethylene (10,000 µg/mL)
2,4-Dichlorophenol
Dichloropropane (10,000 µg/mL)
2,4-Dinitrotoluene (QAR)
2,6-Dinitrotoluene
Ethylbenzene (10,000 µg/mL)
Fluoranthene
4-Chlorophenyl phenyl ether
4-Bromophenyl phenyl ether
bis(2-Chloroisopropyl) ether (QAR)
bis(2-Chloroethoxy) methane (QAR)
Methylene chloride (10,000 µg/mL)
Dichlorobromomethane (10,000 µg/mL)
Hexachlorobutadiene (QAR)
Hexachlorocyclopentadiene
PCB-Aroclor 1232 (QAT)
PCB-Aroclor 1248 (QAT)
PCB-Aroclor 1260 (QAT)
PCB-Aroclor 1016 (QAT)
Toxaphene (QAT)
4,4'-DDT (QAR)
PCB-Aroclor 1221 (QAT)
PCB-Aroclor 1262 (QAT)
PCB-Aroclor 1268 (2,500 µg/mL)* (QAT)
Bromochloromethane (10,000 µg/mL)
2,4-Dichlorotoluene

*In Acetone

**In para-Dioxane

***In 2-Propanol

TABLE 2

EPA REPOSITORY COMPOUNDS

Concentrations are 5,000 µg of QAS-pure compound per mL of methanol solvent unless otherwise noted. (continued)

Phenol
bis(2-Ethyl hexyl) phthalate
Butyl benzyl phthalate
Di-n-butyl phthalate
Di-n-octyl phthalate
Diethyl phthalate
Dimethyl phthalate
Benzo(a)anthracene (1,000 µg/mL)
Benzo(a)pyrene (1,000 µg/mL)(QAR)*
Benzo(b)fluoranthene (2,500 µg/mL)*
Benzo(k)fluoranthene (1,000 µg/mL)*
Chrysene (1,000 µg/mL)*
Acenaphthylene (QAR)
Anthracene (1,000 µg/mL)*
Benzo(g,h,i)perylene (1,000 µg/mL)**
Fluorene
Phenanthrene
Pyrene (2,500 µg/mL)
Tetrachloroethylene (10,000 µg/mL)
Toluene (10,000 µg/mL)
Trichloroethylene (10,000 µg/mL)
Dieldrin (QAR)
Chlordane (QAT)
4,4'-DDE
4,4'-DDD
alpha-Endosulfan**
beta-Endosulfan**
Endosulfan sulfate (QAR)
Endrin (QAR)
Endrin aldehyde
Heptachlor
Heptachlor epoxide
alpha-BHC (2,500 µg/mL)
beta-BHC (2,500 µg/mL)*
gamma-BHC (Lindane)
delta-BHC (QAR)
PCB-Aroclor 1242 (QAT)
PCB-Aroclor 1254 (QAT)
2-Chlorotoluene
3-Chlorotoluene
4-Chlorotoluene
4-Chlorobenzotrifluoride
Pentachloronitrobenzene
alpha, alpha, 2,6-Tetrachlorotoluene
Benzyl chloride
2,3-Dichloro-1-propylene (10,000 µg/mL)(QAR)
1,2-Dibromoethane (10,000 µg/mL)
cis-1,2-Dichloroethylene (10,000 µg/mL)(QAR)
1,2,3-Trichlorobenzene
1,3,5-Trichlorobenzene
1,2,4,5-Tetrachlorobenzene (2,500 µg/mL) (QAR)
2,4,6-Trichloroaniline
3-Chlorophenol
4-Chlorophenol
Chlorodibromomethane (10,000 µg/mL)(QAR)
ortho-Xylene
meta-Xylene
para-Xylene
Bromoform (10,000 µg/mL)(QAR)
1,3-Dichlorobenzene
cis and trans 1,3-Dichloropropylene (5,000 µg/mL each)(QAR)
Mirex (1,000 µg/mL)*
Aldrin (QAR)
2,3,5-Trichlorophenol (QAR)
2,4-Dimethylphenol (QAR)
1,2,3,4-Tetrachlorobenzene (2,500 µg/mL)
Dibenzo(a,h)anthracene (1,000 µg/mL)**
Epichlorohydrin (10,000 µg/mL)
Methyl ethyl ketone (10,000 µg/mL)
Carbon tetrachloride (10,000 µg/mL)

PCBs at 1,000 µg/mL in 5 mL isooctane

PCB-Aroclor 1016 (QAT)
PCB-Aroclor 1260 (QAT)
PCB-Aroclor 1242 (QAT)
PCB-Aroclor 1254 (QAT)

*In Acetone

**In para-Dioxane

***In 2-Propanol